



How close to the coast? Incorporating coastal expertise into decision-making on residential development in Australia



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ABSTRACT

The most recent assessment of the *Intergovernmental Panel on Climate Change* confirms the importance of adaptation strategies such as ‘retreat, accommodate or protect’ but emphasizes the significance of institutional and governance structures in decision-making. Even without the threat of climate change there is a legacy of vulnerable coastal development in many parts of the world where there has been a lack of understanding of coastal processes. Coastal vulnerability and adaptation strategies are well covered in the literature but the extent to which coastal experts are used to advise on development in vulnerable coastal areas has to date received scant attention.

Expert coastal advice is essential to reduce vulnerability of coastal residential development to both existing coastal erosion and flooding and in particular to the threat of increased vulnerability associated with future climate change. This paper uses the Australian system of coastal management, where responsibilities rest mostly with state governments, to discuss the nature of coastal experts and the types of advice they provide. We focus specifically on the relevant legislation, statutory coastal authorities, coastal strategies, coastal planning and decision-making, where there are clear pathways for incorporating expert coastal advice. Only four states have dedicated coastal legislation and each state has its own planning legislation, which is linked to one or more pieces of legislation covering coastal development. Two case studies are used from different states to illustrate how these mechanisms for incorporating expert advice operate in practice. Our analysis includes both anecdotal case studies plus a more detailed quantitative analysis from one state using a decade of records to illustrate temporal patterns in the use of expert advice.

The paper concludes that Australia has a variable use of adopting coastal expert advice into the coastal residential development approval process because each state has different stages where the advice is incorporated into its planning system. These variations can be represented along a continuum of specificity for expert advice provided. It appears that none of the states provides a fail-safe mechanism to prevent residential development being built too close to the coast as shown by case studies described. In one state there is a statutory requirement for referral to an expert coastal body but a proportion of the advice is ignored. Most state jurisdictions are now attempting to mainstream expert advice into planning legislation, policies and guidelines so that best practice principles are adopted early in the development approval process in order to avoid building too close to the coast.

1. Introduction

As development pressure on global coastal environments continues to increase there is an international imperative for adaptation strategies to be used in areas of vulnerable coastal development. The most recent assessment of the *Intergovernmental Panel on Climate Change* (IPCC, 2014) confirms the importance of adaptation strategies such as ‘retreat, accommodate or protect’ but also emphasizes the significance of institutional and governance structures in decision-making, particularly

for planned coastal retreat (Wong et al., 2014). Even without the threat of climate change there is a legacy of vulnerable coastal development in many parts of the world where there has been a lack of understanding of coastal processes.

Existing patterns of coastal erosion or the potential for increased erosion linked to climate change can identify vulnerable coasts but are not necessarily the most important risk factor for coastal development. In fact, some authors downplay the relative importance of climate change as the major risk to property suggesting that increased

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accumulation of wealth in already vulnerable areas is more important in terms of future economic disaster and damage (Bartel and Neumayer, 2012). There are also scenarios where the increased risk exposure caused by coastal population growth can exceed the contribution to risk from projected sea-level rise (Department of Climate Change and Energy Efficiency [DCCEE] 2011). These issues present a challenge for planning authorities given the premium value of coastal land and the need for expert assessment of existing and future coastal risks. A comprehensive approach requires both strategic planning and cumulative impact assessment for future coastal development.

In most cases coastal development decisions are made by state or local government authorities, based on planning guidelines, which incorporate coastal expert advice. State governments use either 'in-house' or external independent expert coastal advice. Development in the coastal zone rarely relies on advice of coastal experts (defined below) alone unless delegation is given to a body of experts within a specific jurisdiction such as a statutory coastal board. Coastal experts can be drawn from a range of backgrounds such as coastal engineers, coastal geomorphologists or coastal and marine biologists and ecologists.

Coastal vulnerability related to climate change and coast protection and adaptation strategies are well covered in the literature for regions such as the United States (Burkett and Davidson, 2012) and Australia (Department of Climate Change [DCC] 2009, DCCEE, 2011). At a global scale these have been extensively reviewed, specifically for coastal impacts, adaptation and vulnerability, in the scientific assessments of the IPCC (Nicholls et al., 2007; Wong et al., 2014). However, the extent to which coastal experts are consulted in planning decisions to avoid or reduce future development in vulnerable coastal areas has to date received scant attention. This paper seeks to address this gap in the literature.

First the paper examines the concept of coastal experts in the context of coastal development and how such expertise is incorporated in early planning stages prior to approvals being given for any future development. The paper focuses on residential development, which has been identified as a major priority in Australian coastal vulnerability assessments (DCC, 2009; DCCEE, 2011), however, the planning and approval processes for residential coastal development vary considerably between the different state and territory governments. Documentation from selected coastal jurisdictions is used to examine what procedures or guidelines exist to incorporate coastal expert advice into decision-making for residential development. The paper does not attempt to present a review of Australian coastal management as this has been covered elsewhere (Harvey, 2016; Harvey and Caton, 2010). Nor does this paper attempt to provide detailed geomorphic/engineering quantitative analyses since no two sites around the 36,735 km Australian coast have the same the same hydrodynamic or sedimentary environment, however, a recent national coastal sediment compartment framework (Thom et al., 2018) provides a first step in forecasting future erosion/accretion trends. In this paper we focus specifically on the relevant legislation, statutory coastal authorities, coastal strategies, coastal planning and decision-making, where there are clear pathways for incorporating expert coastal advice.

Following the above analysis, we investigate how these mechanisms for incorporating expert advice operate in practice by using selected case studies to illustrate the effectiveness of such advice. Our case studies include examples from two different states. Our analysis includes both anecdotal case studies plus a more detailed quantitative analysis from one state using a decade of records to illustrate temporal patterns in the use of expert advice.

Our analysis reveals that the extent to which coastal expert advice is incorporated in coastal development approvals varies around Australia. Existing approaches range from specific government appointed expert 'coastal councils' or 'coastal boards' which have authority to make decisions; to expert boards which provide advice but their advice is not always taken; through to jurisdictions which have no requirement to obtain expert advice for any coastal development. We argue that

decision-makers need to take more note of coastal expert advice. There has also been an increased use of the court system for coastal development in Australia (Bell, 2014). Legal challenges over existing and proposed coastal development take an adversarial approach, which often requires coastal experts on both sides.

2. Who are the coastal 'experts'?

There are many examples of experts at different scales of coastal processes who are used to address issues of coastal erosion and longer-term strategic coastal management issues. At the global scale there are international scientific bodies such as *Land-Ocean Interaction in the Coastal Zone – LOICZ* (Syvitski et al., 2005) or intergovernmental bodies such as the *Intergovernmental Panel on Climate Change – IPCC* (Wong et al., 2014) which attempt to provide expert scientific advice and adaptation options on issues such as coastal vulnerability linked to accelerated sea-level rise associated with climate change.

At a national level, expert advice usually comes from government-funded institutions such as the *US Army Coastal Corps of Engineers* in the United States of America (Houston, 1988) or internationally recognized coastal expert organisations such as the *Delft University of Technology* in The Netherlands (<https://www.tudelft.nl/en/>), which is partially government funded. Expert advice can be included at different stages of decision-making for residential coastal development. At the longer time frame and large geographic scale there is often input from coastal experts into the preparation of:

- national coastal vulnerability assessment and coastal grant/funding programs;
- strategic and regional planning;
- coastal legislation, policies, regulations, guidelines; and
- local government planning and coastal plans

These types of coastal management instruments tend to be general in nature, although some may contain detailed objectives and principles for coastal development in certain areas. For more specific residential development on a particular section of coast coastal experts may be invoked to provide advice:

- major coastal developments such as marinas or canal estates which include significant residential components; and
- minor residential coastal subdivisions or individual residences

In Australia, the national government has little involvement in coastal management since this is the responsibility of the eight state and territory governments under the Australian constitution. At a national level, coastal engineers through Engineers Australia (EA) have contributed to a better understanding of the interaction of coastal processes and built structures, particularly in relation to climate change (EA, 2012a, 2012b, 2013). Australian coastal geomorphologists have also provided expert advice, which according to Thom (2008) has had an impact across seven different areas:

1. vulnerability assessment
2. environmental impact statements
3. coastal management practices
4. coastal planning
5. coastal policy, legislation and regulation
6. decisions of courts
7. communication

A good example of Thom's first area of influence is the *National Vulnerability Assessment* which was produced by the former Australian Department of Climate Change (DCC, 2009). This document drew heavily on expert advice from coastal geomorphologists and coastal engineers and was significant in raising awareness of the need to

incorporate coastal vulnerability into coastal planning and management. In this sense it provided a broad-based national guideline aimed at minimising any future development which might be too close to the coast based on sea-level rise predictions linked to expert understanding of the geomorphic coastal response.

An example of coastal experts being invoked in court decisions (Thom's 6th category) comes from a recent court case in South Australia where local government was challenged over the development of a coastal path in a residential district (Supreme Court of South Australia, 2017). Coastal geomorphologists were employed on both sides as expert witnesses which raises the issue of how experts are selected and how their advice is used. In this case the local expert was able to produce long-term multi-decadal coastal monitoring profiles as evidence of recent erosion patterns.

Although coastal science is an interdisciplinary field, it should be noted that different coastal experts with different disciplinary expertise often have different spatial and temporal perspectives. For example, coastal biologists/ecologists may work on either organism lifespan or population timescales whereas coastal engineers work in design life timespans depending on structures such as a residential building or a seawall protecting public space which may have design lives of 50 and 100 yrs respectively. In Australia, expert advice is dominated by coastal engineers. Geomorphologists, however, tend to work across broader spatial and temporal timescales from instantaneous to seasonal events up to recent geological timescales. A good example of such a geomorphological perspective is the use of secondary sediment compartments at the regional planning scale in Australia (Thom et al., 2018).

While documents such as the *National Vulnerability Assessment* are useful for future planning, it is at the state and local government levels where decisions on coastal residential development are routinely made. This paper examines to what extent these decisions are based on expert advice. The definition of 'coastal experts' in this context is quite clear for a few states which have appointed their own state-based statutory coastal authorities such as in South Australia, New South Wales and Victoria. Each of these authorities have varied roles in decision making for residential development, which is detailed below. Elsewhere, state governments rely mostly on 'in-house' scientists from individual government departments for coastal expertise (see below) and where this is lacking they may use external independent consultants, usually coastal geomorphologists and coastal engineers. In reality much of the planning and development control on the coast is delegated to local government (Harvey and Caton, 2010). At the local government level in most cases there is a lack of resources to employ specialist coastal experts and there is a tendency to rely on state government planning guidelines or where necessary draw on state government coastal expert advice. Thus, our focus is on the use of expert advice primarily at the state and local government levels in Australia.

3. Use of coastal expertise in planning decisions for residential development

In a broad sense the use of any expert advice can be problematical because of the techniques used to incorporate such advice and the context in which it is provided. Sutherland and Burgman (2015) comment on the use of experts in policy-making suggesting a need to engage methodological techniques to make better use of expert advice. Similarly, Rose and Parsons (2015) in an examination of marine science and policy, propose strategies in which marine scientists can better engage with and hence provide more effective expert advice to policy-makers. In an extensive international literature review on advice-taking and decision-making Bonaccio and Dalal (2006) comment on several ways of measuring advice utilisation and conclude that their research on the giving and taking of advice is only a first step toward addressing a gap in the literature on the social context of decisions. The broader social and political context for incorporating expert advice into decision-making for coastal development is a potential avenue of research,

which is beyond the scope of this paper.

One practical way of better using methodological techniques to improve the use of coastal expertise, is through boundary spanning as discussed by Clarke et al. (2013). They suggest that experts such as coastal scientists or engineers can be used in a boundary spanning role between the 'science' and decision-makers and help reduce the science-policy gap.

The role of expert advice can come in different forms. In most cases the experts are consulted to provide detailed technical advice on natural coastal processes such as wind, waves, water levels, sea-level change, current and future sediment budget and erosion or accretion trends. This would include current and predicted anthropogenic impacts such as artificial structures or variations to sediment supply such as reduced river discharge. The type of study varies from detailed investigations usually required for large projects using LIDAR surveys and hydrodynamic modeling to predict sediment budgets, future erosion and coast protection strategies. Less detailed studies may be required for smaller projects. The expert coastal technical advice is then incorporated along with expert advice on other matters such as biodiversity or water quality and is collectively considered in the decision-making process, which will also be influenced by planning regulations, infrastructure requirements and even political factors. Thus the coastal advice will vary in its detail for different projects and will form only part of the decision-making process.

Expert coastal advice on coastal residential development in Australia is generally provided at two different levels which have separate assessment and decision-making processes. First, expert advice on major projects which have associated coastal residential development is usually provided through the internationally recognized environmental impact assessment (EIA) process involving either state-based legislation or if the project is deemed to be of national significance it may also be assessed under national EIA legislation (Harvey and Clarke, 2012). The EIA process will require detailed 'expert' coastal studies presented in some form of documentation which is subject to public scrutiny. The EIA documents are usually prepared by consultants who draw on expert advice from coastal engineers, coastal geomorphologists, marine ecologists and biologists. Decision-making is often made for the whole project giving broad 'in-principle' approval, including any coastal residential components and may include conditions of approval.

Second, and of most relevance for this paper is the use of expert advice for minor projects which is usually provided by 'in-house' state/local coastal scientific expertise or occasionally external specialist coastal expert consultants. There are currently only three state government appointed statutory coastal expert bodies (Table 1), which are linked to specific coastal legislation. These are statutory bodies, which mainly provide advice to the government and in certain cases have delegated decision-making responsibilities. A fourth statutory expert coastal body in Queensland (QLD) called the *Coastal Protection and*

Table 1
State Government appointed coastal expert statutory bodies.

State Government	Coastal Expert Body	Related legislation
New South Wales (NSW)	NSW Coastal Panel*	NSW Coastal Protection Act, 1979 Environmental Planning and Assessment Act, 1979
South Australia (SA)	SA Coast Protection Board	SA Coast Protection Act, 1972 Development Act, 1993 Planning, Development & Infrastructure Act, 2016**
Victoria (VIC)	VIC Coastal Council	VIC Coastal Management Act, 1995

Note: *This Panel will be replaced by a Coastal Council under the new NSW Coastal Management Act, 2016; **this piece of legislation is not yet fully linked to SA Coast Protection Board roles.

Advisory Council linked to the *QLD Coastal Protection and Management Act 1995* was dissolved in 2012 following the *QLD Environmental Protection and Other Legislation Amendment Act 2011*. Similarly, the *Coastal Planning and Coordination Council* is a statutory expert coastal planning body in Western Australia (WA) linked to the *WA Planning and Development Act 2005* but it has not met for four years (Garry Middle pers. com.) The role of each of the current three expert bodies is discussed below.

The NSW Coastal Panel is a statutory authority under the *NSW Coast Protection Act 1979*. It has seven public authority and local government nominees whose role is to provide expert advice to the Minister. Of the current members two are coastal geomorphologists and one a coastal engineer. The Panel has statutory roles in relation to coastal protection works on the open coast or at the entrance to estuaries. Public authorities proposing new works must notify the panel before carrying out these works and take the panel's response into consideration. So far advice has been given on 18 projects proposed by public authorities and on nine residential properties. In general the Coastal Panel's advice in the past has in large part been accepted (Thom pers. comm. 2017). Advice on residential properties relates only to development/protection of existing properties rather than specific advice on proposed new residential development. Any expert advice on new residential development is handled through the state planning system in accordance with approved Coastal Plans (see below). It should also be noted that NSW has recently introduced new coastal legislation (*NSW Coastal Management Act, 2016*) although this is not yet operational. Under the new legislation the Coastal Panel will be replaced by a Coastal Council with a broader strategic and advisory role. Invitations for membership of the Council specified a number of areas of expertise such as 'coastal physical sciences, including geomorphology, coastal engineering, coastal land use planning and coastal ecology'.

The SA Coast Protection Board (CPB) is a statutory authority under the *Coast Protection Act 1972*. It has six members including four public authority and local government nominees plus two members with expertise in coast protection, biological sciences and environmental protection. These two experts are currently a coastal geomorphologist and a coastal ecologist. The CPB provides input to planning strategies and the *Development Plan* and provides responses to development proposals referred to it through the *Development Act, 1993*. The CPB also has statutory roles in relation to works in the coastal zone and there is a requirement for referral for proposals in coastal zones, including residential development. Given the specific role of the CPB in providing expert advice on residential development, South Australia has been selected for a detailed case study later in this paper.

The VIC Coastal Council is a statutory authority under the *VIC Coastal Management Act, 1995*. It has 10 expert members including a coastal geomorphologist and a coastal engineer. A major role for the Council is to prepare a draft *Victorian Coastal Strategy* which is submitted to the minister and once approved becomes a statutory document. The Council also has an important role in statewide strategic coastal planning, coordinating the implementation of the Strategy and Coastal Action Plans and facilitating the operation of the three Regional Coastal Boards. The Council does not, however, have a direct advisory or a directional role on residential development on the coast as such approvals are dealt with by local councils. Given that 96% of the Victorian coast is public land there is usually a buffer of land between any residential development and the coast, thus reducing the chances of building too close to the coast. It should be noted that Victoria has recently proposed new coastal legislation (*Coastal and Marine Act, 2016*) and the Coastal Council and the Boards will soon be replaced.

In addition to the above three statutory bodies, state-based expert coastal advice in most states comes from a variety of sources (Table 2) including coastal units, advisory panels or councils or scientific officers with specialist coastal expertise. Neither the Australian Capital Territory nor the Northern Territory have any dedicated coastal legislation or coastal policy and neither do they have any specialised 'in-house'

coastal expertise. For that reason they are not included in the table below. Not all of the information in the table is readily accessible to the public as many government websites present more generalised organisational charts which don't reveal the level of detail required.

In New South Wales (NSW), the Department of Planning and Environment, Office of Environment and Heritage (OEH) has three divisions that focus on coastal matters. The main one is the Regional Operations Division, providing advice on operational policy, technical advice and support to coastal management. Within this Division there is also a central group providing state-wide coordination, guidance and support. In addition there are four regional units along the coast providing technical support and guidance to local councils. A second Policy Division provides policy and legislative advice and a third Science Division, provides state-wide scientific and research advice. NSW has most of its coastal expertise concentrated in one department making it easier to coordinate advice on coastal development. It has also introduced new legislation *Coastal Management Act, 2016*, 'to enable a more integrated and strategic management of coastal communities'.

Unlike NSW, Queensland has its coastal expertise spread across at least three different departments; Environment and Heritage Protection (Coastal Planning Unit); Science, Information Technology and Innovation; and Transport and Main Roads. Each of these has different expertise and provides advice on the assessment of coastal development proposals against the State Planning Policy and the State Development Assessment provisions. This usually happens when there is a new residential subdivision or material change of use. The advice is considered before the local council makes its planning decision. Much of the state-based expert advice spread across the three departments was formerly concentrated in the former Beach Protection Authority linked to the now superseded *Beach Protection Act, 1968*.

South Australia has the majority of its coastal expert advice provided through its Coastal Management Branch within the Department of Environment, Water and Natural Resources (DEWNR). The Branch contains coastal scientific, engineering and planning expertise, which not only provides advice to local councils and other state government departments but is also the main source of scientific and operational support for the statutory Coast Protection Board. In addition, DEWNR has some coast and marine staff in the Natural Resource Management regions with skills in coastal ecology and/or community engagement.

In Tasmania the former Coastal and Marine Branch in the Environment Division was disbanded after 2011 and there is currently no specified coastal expertise within the Department of Primary Industries, Parks, Water and Environment (DPIWE). Similarly, there is no specified coastal planning expertise in the separate Department of Justice, although Tasmania does have a statutory *State Coastal Policy, 1996* which guides decision-making for coastal development, mostly the responsibility of local councils.

As noted above, the Victorian government has a statutory Coastal Strategy, which forms the state component of any local coastal planning scheme. The Department of Environment Land, Water and Planning does not have any specified coastal expertise or centralized coastal advisory group, however, the Victorian Coastal Council (VCC) does have a broad-based Science Panel of around 60 people. Much of the expert advice provided is at the state level so that neither the VCC or its Science Panel are required to provide advice at the specific residential subdivision level.

In Western Australia, much coastal process expert advice comes from the Coastal Infrastructure Business Unit of the Department of Transport (DoT). This Unit collects and manages coastal data for its own purposes, particularly for the physical characteristics of the coast and coastal hazard risk assessment. The same coastal data and expertise are made available to other state agencies and local coastal managers in decision-making for the WA coast (DoT, 2016). In addition, Schedule 2 of the *WA Planning and Development Act 2005* provides for the establishment of a 'Coastal Planning and Coordination Council' whose duties are 'to advise the [Planning] Commission on matters relating to coastal

Table 2

State Governments with general or specified 'in-house' coastal expertise.

Source: government websites supplemented with information from government employees.

State Government	'In-house' expertise	Related Government Department
New South Wales (NSW)	<ul style="list-style-type: none"> • a) operational policy technical advice; b) coastal policy and legislative reform; c) coastal science and research 	<ul style="list-style-type: none"> • Department of Planning and Environment (Office of Environment and Heritage divisions; a) Regional Operations; b) Policy; c) Science)
Queensland (QLD)	<ul style="list-style-type: none"> • Coastal planning • Coastal impacts • Coastal engineering 	<ul style="list-style-type: none"> • Department of Environment and Heritage Protection (Coastal Planning Unit) • Department of Science, Information Technology and Innovation • Department of Transport and Main Roads
South Australia (SA)	<ul style="list-style-type: none"> • Coastal science and engineering 	<ul style="list-style-type: none"> • Department of Environment, Water and Natural Resources (Coastal Management Branch)
Tasmania (TAS)	<ul style="list-style-type: none"> • General 	<ul style="list-style-type: none"> • Department of Primary Industries, Parks, Water and Environment
Victoria (VIC)	<ul style="list-style-type: none"> • General 	<ul style="list-style-type: none"> • Department of Environment Land, Water and Planning
Western Australia (WA)	<ul style="list-style-type: none"> • Coastal science and engineering 	<ul style="list-style-type: none"> • Department of Transport (Coastal Infrastructure Business Unit)

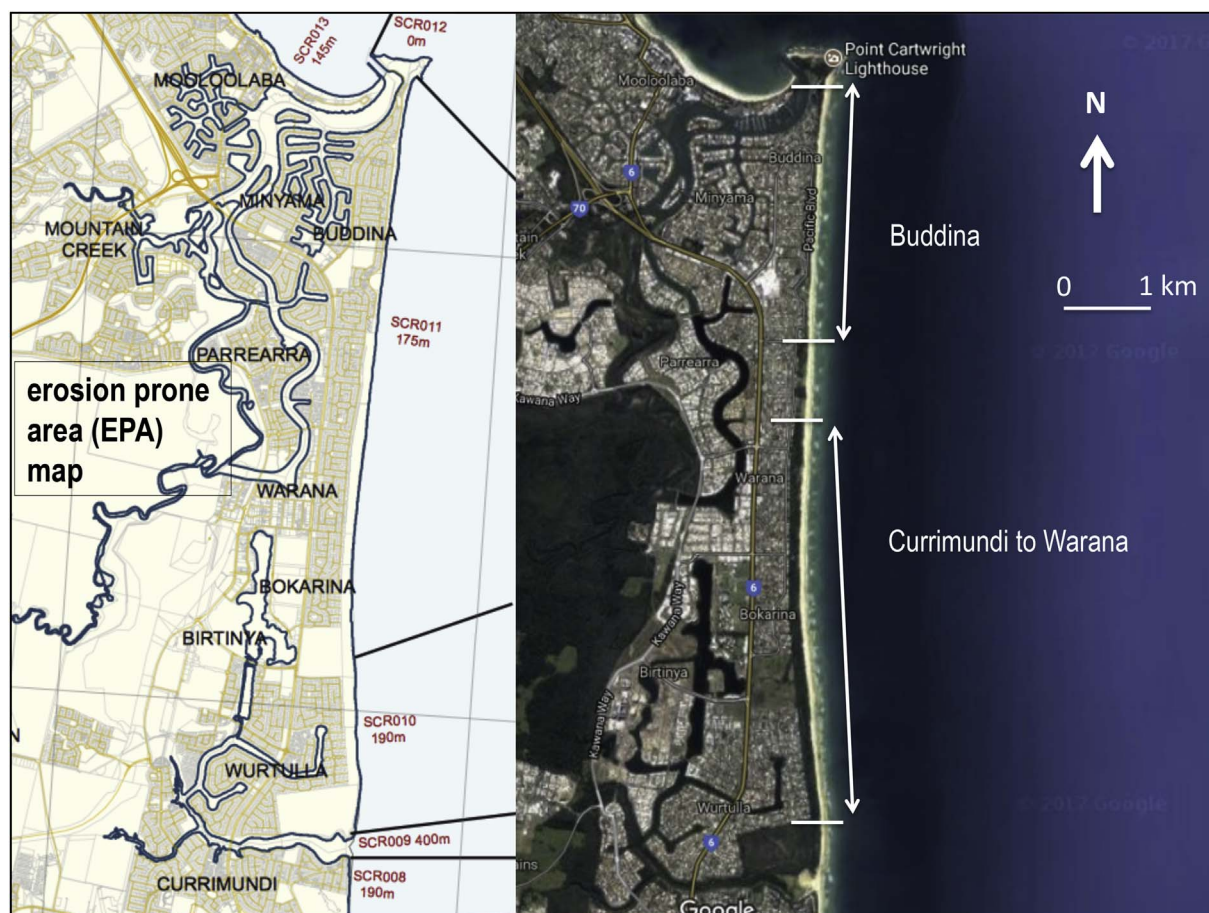


Fig. 1. Google image (right) of part of the Sunshine Coast illustrating a southern section (Currimundi to Warana) where foreshore surrender has occurred providing a buffer to subdivision in contrast to an older area of subdivision to the north (Buddina) where subdivision is closer to the coast. Recommended setback distances for the same erosion prone area (EPA) on left.

planning and coordination throughout the State'. The make-up of this Council is fairly broad with an optional expert in coastal planning. However, as noted above this Council hasn't met for four years and appears to be currently ineffective as a source of expert advice. The new Department of Planning, Lands and Heritage is a merger of former departments and there is no specified coastal coordination unit so far.

4. Use of expert coastal advice in practice

Two contrasting case studies have been selected to examine the use of coastal expert advice in practice. The first illustrates a jurisdiction where there is no longer a state-appointed expert advisory body and coastal expertise is now dispersed across government departments. The provision of coordinated planning, coastal hazard guidelines and plans

in this jurisdiction was seen as reducing the need for access to expert advice. The second illustrates a jurisdiction where a state-appointed expert advisory body is required to provide advice on any development within coastal zones and in some circumstances has a power of direction.

4.1. Case study – Queensland

As noted above, the expert coastal advice in Queensland is provided by three different government departments, which contribute to the assessment of coastal development proposals and subdivisions against the *State Planning Policy (SPP)* and the *State Development Assessment* provisions. In Queensland a key piece of expert advice to avoiding building too close to the coast is the use of erosion prone areas (EPAs),

which provide recommended buffer zone widths for coastal development. As noted by Harvey et al. (2012, p 81), Queensland's coastal governance has a unique 'land surrender' provision under its coastal legislation where the Governor-in-Council can impose a land surrender condition on a proposal for land subdivision in erosion prone land within or adjacent to the foreshore.

The SPP deals with coastal management by providing for the protection of the coastal environment and coastal resources, including protecting the community from coastal erosion, storm tide inundation and sea level rise. The SPP is a statutory instrument that must be integrated into local government planning schemes and development assessment on the coast. Coastal areas of interest are defined through hazard assessment and mapping (EPAs and storm tide inundation areas) and through the Coastal Management District declared under the *Coastal Protection and Management Act 1995*. There is a requirement for EPAs to be considered in any proposed subdivision but once subdivisions have been approved it is the local council, which makes decisions on routine property development and building approvals. The two examples below illustrate how such expert advice can produce 'best practice' outcomes and also how problems can occur when such advice is ignored.

4.1.1. Sunshine Coast, Southeast Queensland

On the Sunshine Coast in southern Queensland the full erosion prone area was dedicated as a Reserve for Beach Protection Purposes as part of the subdivision between Currumbundi Lake and Warana (Fig. 1). This was a voluntary foreshore surrender entered into by the Sunshine Council, State Government and Developers under provisions of the *Beach Protection Act 1968* as part of the approval process for some infill subdivision along the coastal strip. Expert advice from the then *Beach Protection Authority* recommended an increased buffer width following coastal erosion near the Kawana Surf Club, caused by cyclonic swell and storm conditions in 1972. Subsequently the former Landsborough Shire Council and the Queensland Government negotiated with the developer to increase the buffer width. This included a land swap for land at Battery Hill near Caloundra (Tracey pers. comm. 2017).

In contrast, further north at Buddina, older coastal subdivisions with a narrower buffer (Fig. 1) had already been developed at the time of the Kawana erosion event in the 1970s and predated the foreshore surrender policy so that residential development is clearly located closer to the coast.

4.1.2. Bushland Beach, North Queensland

Another example related to expert advice on setbacks and adherence to EPA guidelines comes from north Queensland at Bushland Beach. In this case the EPAs for Bushland Beach were declared in 1984 with original EPA widths as 50 m–80 m and 400 m at creek mouths. The plan of survey for the northern western section of Bushland Beach (Fig. 2) was created in 1992 requiring *Beach Protection Authority* approval under section 45 of the former *Beach Protection Act, 1968* (Prenzler pers. comm.). Although there were land surrender provisions in the former *Beach Protection Act* these would have required agreement of the former Thuringowa Shire Council to accept trusteeship of such a reserve and it is apparent that no such agreement was reached.

The consequential lack of any foreshore land surrender and an inadequate consideration of the recommended EPA setback has resulted in residential development which is too close to the coast at the north-western end of Bushland Beach. Geo-corrected historical aerial photographs of the area clearly demonstrate that this north-western section of the beach prograded seaward between 1941 and 1983 but has eroded markedly since 1983 (Fig. 3). The most recent development application in this area in September 2008 pre-dated climate change considerations (eg allowing for accelerated sea-level rise) in the *QLD Coastal Plan, 2009* but should have been subject to standard erosion setbacks detailed in the original EPAs. This oversight has resulted in residential development being constructed right up to the HAT mark, which has

subsequently required hard rock protection (Fig. 3).

4.2. Case study – South Australia

In South Australia, the statutory Coast Protection Board (CPB) is the primary authority providing expert advice on coastal development. Two examples are listed below where the advice of the CPB was 1) ignored by the state government for political reasons, and 2) where a proportion of the CPB advice has been ignored at the local government level. Each of these has different consequences.

4.2.1. Political decision ignoring expert advice from the Coast Protection Board

South Australia, in 1992 was the first state government to introduce a comprehensive policy on flooding and erosion guidelines for new residential coastal development. This policy, which was built into the planning system avoided building too close to the coast by using setback boundaries for new development incorporating an allowance for 100 years of erosion and IPCC predicted sea-level rise to the year 2100. The introduction of the state-wide policy highlighted an inconsistency for numerous shack settlements (Fig. 4) around the coast which were built on crown land with limited tenure (often a 99-year lease).

As noted by Harvey and Caton (2010, pp 169–170) there was a major conflict between expert coastal advice provided by the CPB and political decision-making related to the freeholding of around 1600 coastal shacks. The CPB essentially advised the government against this move as it was inconsistent with government policies on coastal development. An independent review titled 'Assessment of Crown Lease Coastal Shack Sites in Accordance with Environmental Sustainability Criteria' (PPK, 1991) was conducted according to specific criteria including that the shacks should allow reasonable dune and beach management and should not be threatened by coastal flooding or erosion. The review was prepared by consultant engineers with coastal expertise. The report found that only 5% of the 1600 shacks met all the criteria, although some had the potential to meet them. Notwithstanding the advice from the Review and the opposition from the CPB the newly elected state government was strongly influenced by political pressure from the shack-holder lobby group and decided to freehold all shacks through the introduction of a minister's coastal planning document in 1996. This essentially created two different planning standards for coastal developments in SA, one for shacks and another for all the rest.

4.2.2. Local government decisions ignoring advice from the Coast Protection Board

Coastal development proposals in SA have been processed through state planning regulations under the *Development Act 1993*, recently superseded by the *Planning, Development and Infrastructure Act, 2016*. The majority (> 80%) of coastal development applications under the *Development Act* required planning authorities to 'have regard' to Coast Protection Board (CPB) advice (Coast Protection Board, 2013). Regulations attached to the planning legislation (Schedule 8) require, with some exceptions, that applications for development on 'coastal land' have to be referred by the relevant planning authority (most commonly the local council) to the CPB for 'advice' or 'direction'. In the case of coastal land, planning authorities are subject to the 'direction' of the CPB which may either direct refusal of an application or direct that specific conditions be attached to any approval. The latter can occur if the development involves either more than nine cubic metres of excavating or filling of land, or the construction of coastal protection works within prescribed distances of high water mark depending on the setting.

The CPB provides expert coastal advice for coastal development in two ways. First it provides advice and input to the state Planning Strategy and the regionally specific Development Plans related to this strategy. More specifically the CPB provides specific advice on

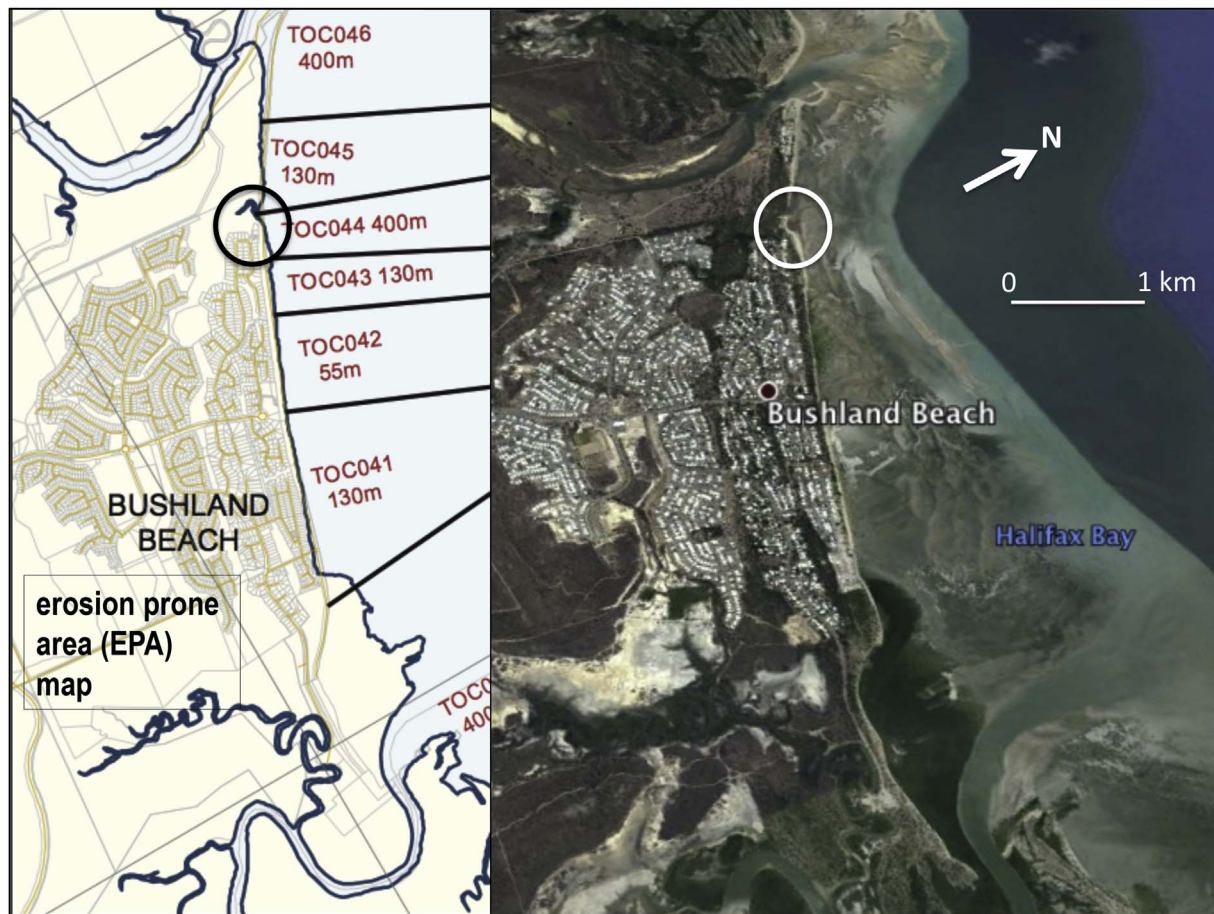


Fig. 2. Google image (right) of Bushland Beach illustrating residential development at the north-western end compared with recommended setback distances for the same erosion prone area (EPA) on left.

Source: aerial photos, Google Earth.

development applications on 'coastal land' although the CPB has noted (CPB, 2015) that 38% of SA's coastal hazard zones are still not yet classified as 'coastal land' because the process of classification has been either slow or unsuccessful.

Although the CPB has a legislative role in the assessment of coastal development, a significant proportion of coastal development has been approved against CPB advice. According to the CPB "this places individuals and the wider community at increased risk of incurring future costs associated with addressing coastal hazards" (CPB, 2015 p iv).

In 2004 Huppatz (2005) reported that 19 per cent of development applications reported by planning authorities were approved despite being 'not in accord' with CPB advice. There is no provision in the coastal legislation to advise vendors of the fact that expert advice has been ignored. According to the CPB between 2004 and 2013, 276 dwellings and 126 extra allotments were approved contrary to the CPB advice regarding coastal hazards. A recent audit conducted by the CPB (2014) illustrates the extent to which the expert coastal advice of the CPB has been ignored by decision-making authorities over the last decade (Fig. 5). This shows a maximum of just over 18% of CPB advice ignored in 2005. This fell to under 10% in 2005 but rose again to over 16% in 2010 before falling to the present level of just over 8% in 2014.

The declining trend of DNFs 'not in accord' with CPB advice implies that there has been a gradual increase in the acceptance of expert advice to a level of just over 90%. The CPB in its audit report suggests a number of reasons for this such as:

1. an increase in compliant applications
2. successful negotiations with developers and relevant authorities

3. better coastal zoning
4. changes to the Coast Protection Board Policy
5. fewer advised and directed refusals

The CPB also notes that over this period there has also been a decline in residential development which usually accounts for about 50% of the decisions not in accord. According to Pelton (2016) local government's main source of revenue is property rates, and for this reason there is considerable pressure to adopt a pro-development approach for local residential development.

An additional problem occurs where a Council re-zones a 'coastal' zone to a different zoning category thus preventing the statutory referral of development applications in the zone to the CPB. For example this happened at Smoky Bay, South Australia where a section of coastal land (Fig. 6) originally zoned as 'Urban Coastal' was rezoned as 'Residential' against the expert advice of the CPB. This forms part of a larger state-wide issue where 38% of coastal hazard areas are outside coastal zones in SA (CPB, 2014).

5. Discussion

Australia already has a significant number of coastal properties at risk from future erosion and/or flooding as documented by the National Coastal Vulnerability Report (DCC, 2009; DCCCE, 2011). There is a concern that any future development should not increase the number of properties or people at risk particularly with the threat of climate change induced increases to flooding, erosion and sea-level rise. While climate impacts are an important component in the overall risk

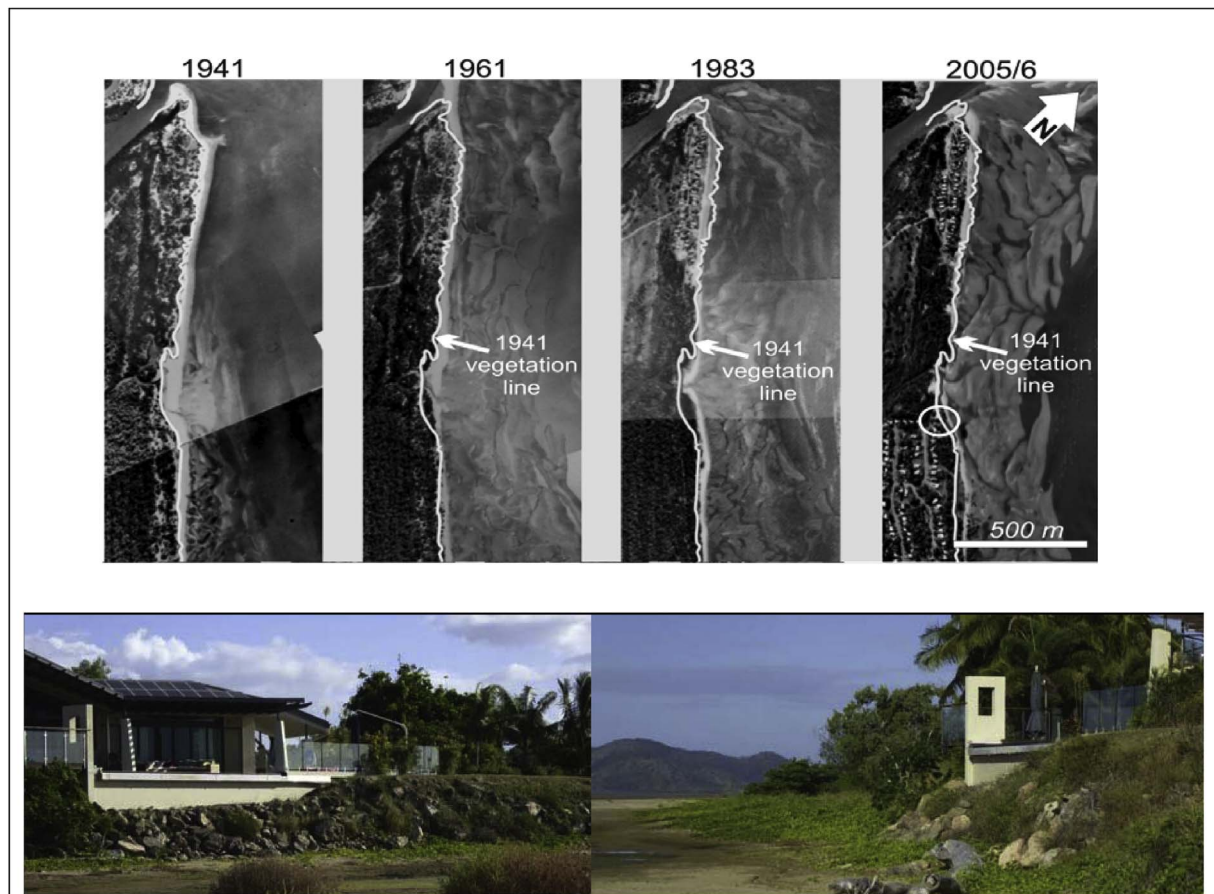


Fig. 3. (Upper) Historical shoreline change at north-western Bushland Beach reconstructed from geo-rectified aerial photographs at approximate 20 year intervals from 1941; (Lower) Residential development at the north-western end of Bushland Beach where construction has taken place up to the highest astronomical tide and has subsequently required rock protection.

Source: aerial photos, Google Earth; location photos, N Harvey.



Fig. 4. Shack development too close to the coast on Yorke Peninsula, South Australia at Black Point (left) and Chinamans Well (right) (photos: N Harvey).

assessment a major concern is to avoid approval of new development in vulnerable coastal locations. As noted by the IPCC, institutional and governance structures in decision-making for coastal development are important (Wong et al., 2014) particularly as poor coastal management decisions may constrain future adaptation options such as in the case of canal estates, where the ‘retreat’ option may be limited. For this reason it is important for government structures to have mechanisms both for providing expert advice by coastal experts in coastal development processes and for implementing more rigorous and binding evaluation mechanisms for the effective use of that advice.

Ideally, coastal experts should provide advice at incremental stages

of residential coastal development. Initially, the proponent should obtain expert advice on the preparation of the proposal in the form of background coastal process data identifying potential need for further detailed studies. For major developments privately funded technical consultant advice may be needed in addition to any general advice provided by government. This could include detailed morphodynamic and hydrological modeling studies. Once the proposal has been submitted to government for planning approval it may be referred to a statutory coastal authority or to departmental ‘in-house’ coastal expertise to check compliance with regulations and to provide informed technical advice on coastal processes and management implications of

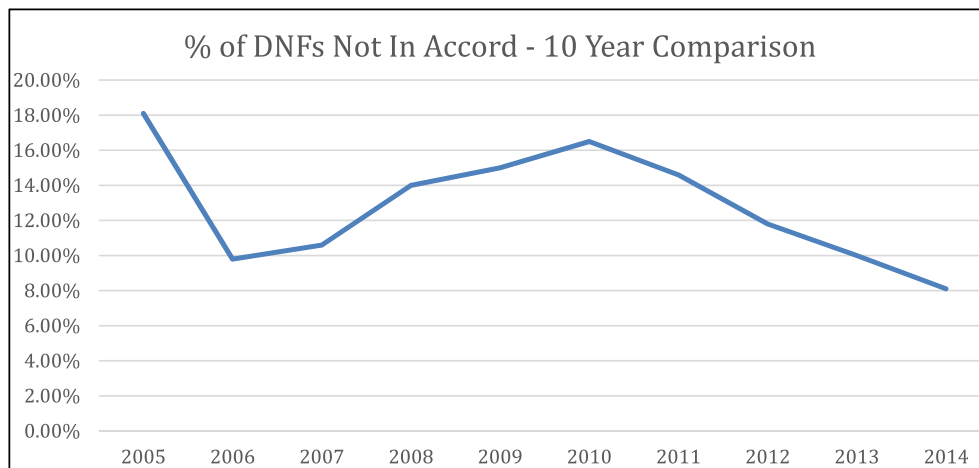


Fig. 5. Percentage of Decision Notification Forms (DNFs) not in accord with CPB advice between 2005 and 2014.
Source: Coast Protection Board, 2014.

the proposal. At this stage, it is up to the decision-makers to determine if they have sufficient expert advice to make an informed decision. If not, further studies may be required. Even once a proposal receives planning approval it may be subject to conditions requiring further studies and in most cases any coastal structures will require endorsement from an authorised expert coastal engineer.

As discussed earlier, there are only three states which have statutory coastal authorities linked to coastal legislation although there used to be four (see Harvey and Caton, 2010). While this could suggest that these states place a greater value on expert coastal advice than other states, the fact is that the expert advisory role of each of the coastal authorities varies. For this reason, it is important to analyse how each of these authorities operate in practice. On the other hand, Queensland which dissolved its statutory coastal authority, is now attempting to provide ‘in-house’ expert advice through a number of government agencies but with an increased reliance on tightened regulations, which enshrine more explicit coastal development outcomes within state planning legislation. Thus the difference in expert advice provided by statutory coastal authorities compared to government ‘in-house’ expertise is not straightforward and any comparison is further complicated by the variation in legislation and policies between the states.

This paper has demonstrated the importance of both invoking expert coastal advice for proposed residential development and for ensuring that this is incorporated in decision-making in order to minimize vulnerability, future risks and also future liability for decision-makers. In Australia most decisions on residential coastal development are made

at the local government level which rarely has the resources to fund its own expert coastal advice. Most advice has been incorporated into state government planning regulations, development controls, and guidelines or directives on risk management and erosion control. There is a variable level of state control or influence on local government decision-making for residential development. In addition to expert advice being incorporated into planning schemes, some states have either ‘call-in’ powers for certain types of coastal development or even refer all coastal development within specified ‘coast zones’ to an expert coastal body. The level of specific advice can be represented along a continuum of specificity as illustrated in Fig. 7. At the left-hand end of this continuum expert advice is less conspicuous because it has been incorporated into planning regulations. At the right-hand end the advice is quite specific and can be made by coastal experts for the detailed level of an individual coastal residence.

Most states are represented on the left of this diagram but the Queensland system for example equates to the middle of the continuum whereby certain types of coastal development involving material change of use or new development on coastal properties have to be referred to the State Government for expert advice. The government then has the power of refusal. In Queensland, the coastal expertise which was originally concentrated in its state expert coastal authority, the *Beach Protection Authority* and subsequently the *Coastal Protection and Advisory Council* has now been dispersed across at least three different departments. Since 2013 there has been a concerted effort to incorporate as much expert scientific advice into the planning system so

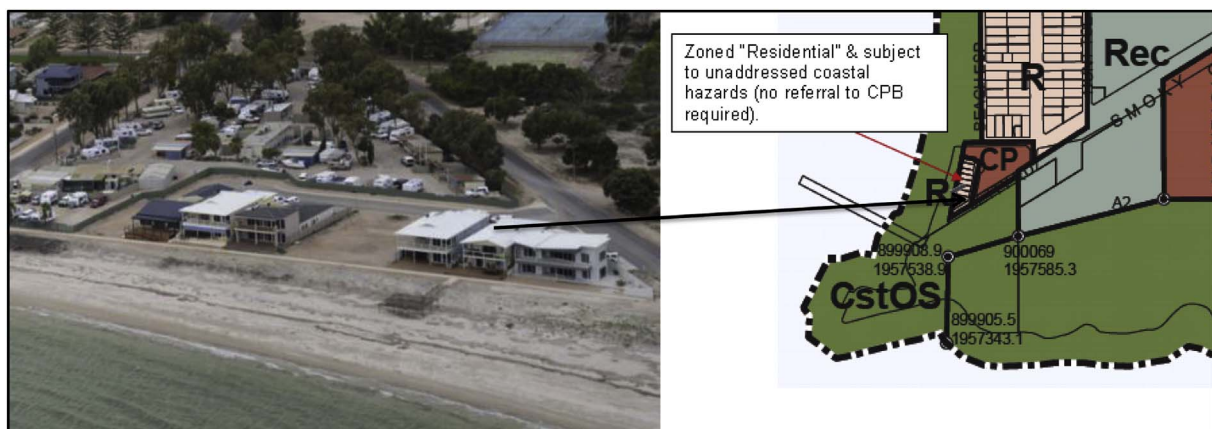


Fig. 6. Land shown at Smoky Bay, South Australia, originally zoned “Urban Coastal” but rezoned “Residential” against advice of the Coast Protection Board.
Source: Coast Protection Board, 2015.

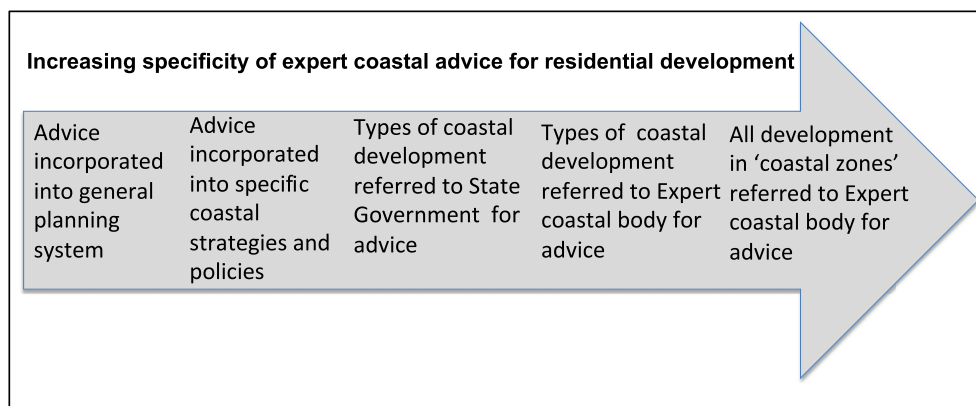


Fig. 7. Levels of expert coastal advice ranging from general inclusion in the planning system through to individual coastal development applications requiring statutory referral for expert advice.

that generic coastal development issues are captured at an early stage. As a result, examples of best practice such as the Sunshine Coast case study should become more common and sub-optimal outcomes of building too close to the coast as happened in the Bushland Beach should become rarer. In order to avoid the latter, it may be necessary to strengthen regulations where decision-makers are required to adopt the advice of coastal experts rather than have the option of ignoring it.

The most detailed level of expert advice, represented on the right of the diagram, comes from South Australia where there are requirements for local government to refer all development in 'coastal zones' to the state-appointed coastal expert body, the CPB. While this system is designed to maximise the use and effectiveness of expert advice for sensitive coastal developments, it has been shown in this paper that there are 'in practice' examples where the effectiveness of this expert advice was diminished. First, a political decision in 1994 to freehold coastal shacks was inconsistent with the state's own coastal policies and was also against the advice of the CPB. Second, the analysis of a decade (2003–2014) of local government decisions, requiring consideration of CPB expert advice, revealed that nearly 300 dwellings and over 100 extra allotments were approved over that time, contrary to the CPB advice. Third, rezoning of some land originally zoned as 'Coastal' to 'Residential' has been made against advice of the CPB.

Ignoring expert advice in SA has increased the number of coastal residential development properties where coastal hazards have not been addressed. The most dramatic illustration of this is the political decision to freehold coastal shacks which did not comply with the government's own policy on protection for such development from erosion and flooding. It also ignored the expert coastal advice from the Coast Protection Board. One consequence is likely to be an increased capitalization in already vulnerable areas as property owners granted freehold tenure tend to invest more money in their property. The government is now providing assistance to help groups of shack owners prepare their own protection strategies, although the government has stopped short of funding the actual protection works. Similarly, the number of local government decisions which have ignored CPB expert advice will not only increase the number of potentially vulnerable coastal properties but may expose individual councils to liability and future legal challenge. Given the recent introduction of the *SA Infrastructure and Development Act*, it will be interesting to see if the CPB retains the same level of referral as it did with the previous planning legislation.

As noted above, when the system fails legal challenges to coastal development can occur. This adversarial system will often require expert coastal advice for both sides. This failure of the system usually happens when either the planning regulations are unclear or open to interpretation or where the decision-maker has not followed correct procedures. Such challenges are less likely when there has been specific referral back to state government or statutory expert coastal bodies.

6. Conclusion

Expert coastal advice is essential to reduce vulnerability of coastal residential development to both existing coastal erosion and flooding and in particular to the threat of increased vulnerability associated with future climate change. Given the fact that coastal management responsibilities in Australia rest with state governments rather than the federal government, there are a variety of mechanisms by which coastal expert advice on residential development is provided in each state. This is primarily because each state has its own planning legislation, which is linked to one or more pieces of legislation covering coastal development. Only four of the six states discussed have dedicated coastal legislation and no two states have the same mechanism for providing expert advice.

This paper has demonstrated that Australia has a variable use of adopting coastal expert advice into the coastal residential development approval process because each state has different stages where the advice is incorporated into its planning system. These variations can be represented along a continuum of specificity for expert advice provided. Notwithstanding, the different approaches it seems that none provides a fail-safe mechanism to prevent residential development being built too close to the coast as shown by case studies described in this paper.

In the one state where a statutory requirement for referral to an expert coastal body prevails it appears that a proportion of this advice may not be fully followed while the legal requirement is 'to have regard to' the advice rather than the expert body being able to issue a binding directive. Most state jurisdictions are now attempting to mainstream expert advice into planning legislation, policies and guidelines so that best practice principles are adopted early in the development approval process and inappropriate building developments too close to the coast are avoided.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.ocecoaman.2018.03.007>.

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